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extension. . . . It is well known in the art that a source and drain are identical structures in the device and are only designated by the term "source and drain" to distinguish how the circuit is biased, in which case a source and drain are interchangeable [see Liu et al. (US 6,218,276 B1) in col. 4, lines 29-30].

The Examiner also responds to the remarks in the previous Response stating:

Applicant's arguments filed with respect to claims 18-37 . . . are not persuasive. . . . The examiner does not deny that the function of a source differs from the function of a drain, but still contends that because a source is structurally the same as a drain, any such structure, which is formed by implanted dopants in a substrate on opposing sides of a gate and having a channel in between them, can be designated as either a source or drain. . . . Distinction in this case relies on "structural" differences in the semiconductor devices. Because a source and drain are "structurally" the same, there is no distinction in making one designated impurity region different in depth than the other.

Applicant respectfully traverses the rejection for the same reasons discussed in the response to the previous Office Action. Kadosh is referred to below as the cited art.

As a preliminary matter, Applicant notes that the Examiner has not addressed the remarks in the previous Response related to the dependent claims. Applicant reasserts that dependent claims 19, 20, 26, and 36 are additionally patentable for the reasons stated below.

Dependent Claims 19 and 20 recite a feature wherein the source extension is more heavily doped than the drain extension. Even assuming for the sake of argument only that the Examiner's contention that the source and drain extensions are readily interchangeable to meet the limitations of the independent claims of the present application, Kadosh discloses the opposite structure as recited in Claims 19 and 20.

In Claim 19, the source extension, the shallow extension, is more heavily doped than the drain extension, the deeper extension. In contrast, Kadosh clearly shows that the deeper extension is more heavily doped. See Figure 1U of Kadosh. Applicant respectfully submits the Examiner cannot interchange the terms "source" and "drain"

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in the dependent claim from their modified meaning given by the Examiner in the independent claims. Applicant respectfully submits that the Examiner, without explanation has used one definition for source and drain in the independent claims and then reverts back to the original meaning of "source" and "drain" to teach the limitations of the dependent claim. Applicant respectfully submits that the Examiner is attempting to have it both ways.

The Examiner must provide a suggestion in Kadosh to make the shallow extension more heavily doped, especially since such a feature is in contrast to the conventional wisdom in which deeper extensions are more heavily doped. Further, Kadosh teaches the exact opposite structure than that in claims 19 and 20 when the terms "source" and "drain" are interchanged as set forth by the Examiner. Therefore, Kadosh is clearly teaching the opposite structure recited in Claims 19 and 20. Accordingly, Claims 19 and 20 are additionally patentable over Kadosh.

With respect to dependent Claim 26, the ratio of dopants between the source extension and drain extension is recited as being approximately 5. In contrast, Kadosh discloses a concentration ratio of 10-100 times. Kadosh, col. 3, lines 29-33. Clearly, the ratio of dopants is different than that as claimed in dependent Claim 26. Further, no suggestion to increase the dopant ratio of Kadosh by 2-20 times. Therefore, it is respectfully submitted that Claim 26 is additionally patentable over the cited art.

Further still, Claim 36 recites a unique concentration of dopants associated with the deep source and drain regions and the source extension and the drain extension. As discussed in the previous response to Office Action, Kadosh teaches the use of a deep source region having a different concentration of dopants than the deep drain region, and the deep source region having a higher concentration of dopants than the drain extension. In contrast, Claim 36 recites that the deep source in drain regions have the same dopant concentrations. Further, the range of concentrations recited in Claim 36 for the deep source region is outside of the range disclosed in Kadosh. There is simply no suggestion for altering the concentration of dopants in Kadosh to meet the limitations of Claim 36. Accordingly, Applicant respectfully submits that claim 36 is additionally patentable over Kadosh.

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With respect to independent claims 18, 21, and 31 and as discussed in the previous Response, Applicant respectfully submits that the terms "source and drain" in the present application are defined consistent with the IEEE Standard Dictionary of Electrical and Electronic Terms. Applicant's attorney agrees that the term "source and drain" may be interchangeable when the source and drain are in fact the same structure. However, this is not the case in Kadosh or in the present application. Indeed, these are asymmetric transistor structures wherein the function of the source and drain are not identical, a point well understood by one of ordinary skill in the art.

Applicant acknowledges that Lu states the drain and source are interchangeable. However, this statement relates to symmetric transistor in which the source and drain are identical. This structure is not consistent with the asymmetric structure of Kadosh and the present invention. Further, this statement does not apply in this case, in which the distinction between the source and drain cannot be ignored.

With respect to the Examiner's position that the source and drain structures are merely a structure of a doped region, without regard to their intended biased condition, Applicant notes that this position unfairly minimizes the importance of the structure with respect to the transistor as a whole. Various other IC structures are also simply doped regions within a substrate, such as, a channel region or a halo region. Indeed, the halo regions could probably be biased in such a way as to perform in a similar fashion to source and drain regions. This ability to so bias a transistor does not make halo regions interchangeable with source and drain regions.

Each of independent claims 18, 21, and 31 recites a feature in which the drain extension is deeper than the source extension. This structure provides significant advantages. More particularly, the shallower source extension and deeper drain extension achieves at least three beneficial effects: 1. Substantial immunity to short channel effects; 2. reduced peak electric field in the channel region reduced possibility of hot-carrier injection into the gate oxide; and 3. higher drive current. See present application, page 3, lines 1-10. The shallower source extension allows the transistor to achieve control of short channel effects and higher drive currents and yet the deeper drain extension allows the transistor to reduce hot carrier injection stress. See present application, page 5, line 15 - page 6, line 7.

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Kadosh does not disclose or suggest the structure recited in independent claims 18, 21 and 31. Indeed, Kadosh shows a drain extension which is shallower than the source extension. There is no suggestion in Kadosh to exchange the source extension with the drain extension. Not only does Kadosh not provide a suggestion for the structure in the present application, it teaches precisely the opposite structure. Therefore, claim 18 and its dependent claims 19-20, claim 21 and its dependent claims 22-30 and claim 31 and its dependent claims 32-37 are patentable over the cited art.

As shown in Figure 1U, both transistors of Kadosh have a drain extension that is shallower than the source extension. There is clearly no suggestion for the opposite structure recited in the claims 18, 21 and 31 because nowhere in Kadosh does it mention that the source and the drain extension are interchangeable. Indeed, the specification of Kadosh lists a myriad of alternatives and not one of the alternatives mentions a substitution of the drain extension and the source extension. Kadosh, Col. 10, lines 4-60. Accordingly, claim 18 and its dependent claims 19-20, claim 21 and its dependent claims 22-30 and claim 31 and its dependent claims 32-37 are patentable over the cited art.

Further, although Kadosh mentions the advantages of lower source drain resistance and reduced hot carrier effects, it achieves these advantages by relying on a structure with a lightly doped drain, a heavily doped deep drain and ultra-heavily doped deep source. Kadosh, Col. 3, lines 9-15. If one of ordinary skill in the art used Kadosh in pursuit of the advantages mentioned by the Examiner, that person would fabricate an asymmetric transistor with a heavily doped deep drain and an ultra-heavily doped deep source. Reducing the depth of source extension would not even be considered, especially when Kadosh clearly shows a deeper drain extension. Accordingly, claim 18 and its dependent claims 19-20, claim 21 and its dependent claims 22-30 and claim 31 and its dependent claims 32-37 are patentable over the cited art.

Yet further, rather than relying on ultra-heavy doping of a deep source region, the transistor recited in independent claims 18, 21, and 31 achieves significant advantages with a more elegant structure, a shallower source extension and a deeper drain extension. Achieving advantages with a structure of reduced complexity is strong indicia of nonobviousness. Accordingly, claim 18 and its dependent claims 19-

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20, claim 21 and its dependent claims 22-30 and claim 31 and its dependent claims 32-37 are patentable over the cited art.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date 6/24/02By 

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